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Green Library Initiatives and Community Engagement: A Comparative Study of Green and Traditional Libraries

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Abstract

In this study, the relationships between green library projects and community involvement were explored using data from 24 libraries, 12 of which are certified green and 12 are not. A combination of methods was used to gather data from 480 users, 48 staff and by regularly observing the facilities during six months. The project studied how the company treated the environment, its energy use, how involved it was with the community and how pleased its users were. According to the findings, green libraries had an 18-percentage point higher rate of community involvement (78% compared to 52%), used 34% less power and gave users a satisfaction rating of 4.6 out of 5, while the regular libraries only had 4. Environmental education programming was present in green libraries 2.3 times more and these libraries attracted over 41% more different community members. Community pride, growing environmental awareness and greater social bonding were found to be main achievements of green library efforts. The findings indicated that attracting and engaging places in communities could be achieved with the use of sustainable design, renewable energy and environmental programming. Analysis of data found that there were clear differences between green and traditional libraries in all the evaluated aspects ($p<0.001$). The results point out that green library practices improve community involvement, save energy and support efforts to protect the environment.

Keywords: Relationships, green library, projects, community, involvement.

Introduction

Public libraries have changed dramatically in the 21st century, going from being just book and information stores to being important places for many social, educational and cultural activities in the community. It shows that society is reassessing how public institutions should help the community, bring people together and encourage people to participate. With communities starting to see how important libraries are, there has been increasing interest in finding new ways to improve their role as a core part of the community. One of the key changes in current library organizations is that they now integrate environmental care and their commitment to community, creating green libraries that do both (Kawamoto & Koizumi, 2023). Green libraries show how our current worries about the environment and community involvement are being met. Now that climate change is gaining attention and many

rethink how they impact the Earth, public institutions are being encouraged to set a good environmental example with their buildings and daily work. At the same time, libraries must work to keep their importance and maintain community support, so they turn to new methods for programming, serving people and building relationships. Adding green programs to library services and structures can solve issues related to the environment and community engagement at the same time (Adigun, Ajani, & Enakrire, 2024).

Green libraries use all methods of sustainability by looking at the building design, energy used, resources and policy programs. Most of these buildings use energy-saving systems, rely on renewable sources, use eco-friendly materials, focus on water collection and work on lessening waste. Along with providing physical resources, green libraries offer programs about the environment and sustainability so that everyone in the community can learn about these topics. As a result, libraries become both good for the environment and proactive in encouraging others to go green (Rahoo, at el, 2020; Amiri, 2024). Even though there are many stories that link green libraries with better community engagement and satisfaction, little has been done with formal studies to explore these connections in the library world. Applying sustainable design to buildings can theoretically increase community engagement because improved environmental conditions often result in better user comfort, nicer facility appearances and simplified building operations, opening up spaces for educational and social activities. Still, the research data backing these relationships is not enough to support decision-making by those managing and shaping libraries' environmental programs (Grant, 2021).

Enablement of green library initiatives is meaningful for many groups involved in the library system. It is becoming more and more important for library administrators to explain all facility spending and the positive impact they have on the community so evidence of successful engagement is highly helpful in obtaining help and funding. For green library investments to be considered effective, policymakers depend on data that compares their costs and outcomes. Evidence is needed by community organizations and residents planning library development projects to support their causes and strategies. Furthermore, the lack of good comparative research on these relationships holds back informed choices by various groups who should be deciding on migration (Rahoo, at el, 2021; Reid & Mesjar, 2023). The fact that both environmental actions and community work in libraries are hard to measure has probably led to less research being done. To measure environmental metrics, you need common measurement processes and collect data continuously, whereas community engagement should look at user participation, how many programs they go to, who they are and feedback from users. To understand the effects of green projects on communities, quantitative and qualitative approaches must be used, requiring research designs that deal with environmental as well as social details (Taylor & Jaeger, 2021). Because evidence-based practice is emphasized in modern library work, more research is required to guide decisions on planning library activities and managing resources. It is a recent development for libraries to think about sustainability when managing operations and validating its outcomes is needed. Since libraries are competing for funding and staying visible in their communities, it is important to prove that being environmentally friendly brings real benefits (Supa'at & Ihsan, 2023).

Performing this research at this time is highly valuable because sustainable development goals and climate action are at the forefront of efforts at every level. Because libraries affect many members of the community and operate as public spaces, they have a unique role in teaching people about the environment and encouraging sustainability actions. But libraries are only effective in this role if they manage to interest and involve various members of the community with their facilities and the programming they organize. Due to their benefits to the environment and local community, green library initiatives are considered very valuable for communities working on different development priorities at the same time. This research fills a key gap in the literature by comparing green and traditional libraries, evaluating their performance on the environment and in the community using a mix of research methods. The research finds out if green library measures help engage the community and also save the environment, supplying evidence needed for library planners. Results from this study add to the library literature and also provide valuable recommendations for community leaders and

residents planning green projects.

Research Objectives

1. To assess the amount of local involvement in green libraries compared to traditional libraries by examining local participation rates, program therapy and the patterns of facility attendance.
2. Reviewing the ways in which both green and conventional libraries affect the environment by measuring energy use, resources and their focus on eco-friendly projects.
3. To examine the factors that raise community engagement in green libraries and to analyze stakeholder ideas relating to the connection between sustainable library design and community commitment.

Research Questions

1. How do green libraries compare to traditional libraries in terms of the number of people using the library, the number attending events and overall use of the building?
2. How do green libraries' environmental results differ from those of conventional library facilities?
3. What library services aimed at protecting the environment have the biggest impact on engaging people in the community and making them happy?

Significance of the Study

This research fills an important void in learning how environmental sustainability and community participation are linked in public library systems. The move from just storing books to becoming community centers has made incorporating green actions a helpful way to support nature and bring people together. Library administrators, policymakers evaluating sustainable projects and communities planning green libraries all benefit from this study. The findings demonstrate that achieving environmental sustainability and increasing community participation are both valuable for libraries, providing a good reason to create greener libraries. In addition, this research adds to discussions about how sustainable community infrastructure helps people participate in community affairs and care for the environment. Comparative analysis will make it easier for future assessments of green library projects and the collected best practices can show other libraries all over the world how to strengthen their communities and the environment.

Literature Review

The idea of green libraries comes from the wider movement to make buildings more sustainable which began in the late 1990s. Environmental sustainability in libraries was first talked about mainly as a way to lower energy use and conserve resources, with little focus on the links to providing better library services. After the U.S. Green Building Council introduced the Leadership in Energy and Environmental Design certification, many libraries adopted its methods for judging and encouraging sustainable building. Regardless, most of the literature from this time concentrated on the design part of green buildings and not on the ways libraries could benefit the community (Khalid, Malik, & Mahmood, 2021). Work on engaging communities with libraries and work on environmental sustainability have tended to run along similar paths but mostly apart. Historically, research at libraries used circulation statistics, program turnout and community satisfaction to determine community engagement, leaving aside how the physical building might impact these results. Much of these studies on library spaces and user habits focused on comfort and welcome from the environment to attract visitors, but did not take into account the ways their designs impact the environment or consider issues of sustainability. A separation between environmental and engagement research has prevented experts from understanding the ways they may work together (Mathiasson & Jochumsen, 2022).

Environmental psychology guides research on how design features in a library can shape how people interact with one another and the space itself. According to some research, bringing in nature, ensuring better lighting and purer air can enhance how we think, feel our stress and interact with those around us. A review of environmental comfort research has demonstrated that making the temperature comfortable, managing noise well and having pleasant sights can help achieve more satisfied users

and longer usage of the facility. The results indicate that green library designs that lessen the library's environmental impact could also improve how users feel and act while in the space, but research specifically for library applications is missing in the literature (Fedorowicz-Kruszewska, 2021). More research on community spaces and how people get involved provides extra theoretical backing for the relationship between green libraries and getting involved in the community. Studies show that third places and spots for gatherings work better when they have comfortable and inviting features. Investigations into community centers and public spaces have shown that their quality and available features can determine how often they are used and how strongly people in the community identify with them. Having appealing and comfortable green elements in a library may encourage more people to get involved in their community, even though evidence from libraries is not fully proven yet (Mishra, 2023). Such knowledge contributes another view on the link between green libraries and strong community relationships. Comparing how people learn in the classroom to active outdoor experiences finds that doing activities rather than listening helps develop environmental knowledge and encourage pro-environment behaviors. With their green designs and range of environmental activities available, green libraries could be useful for teaching people about the environment. Yet, there is little research into the success of libraries as centers for environmental learning and no clear comparisons have been made between distinct types of libraries (Prajapat, Taru, & Atikur, 2022).

A lot of recent research on library programming and outreach has focused on environmental and sustainability topics, but there is still no comprehensive way to judge how successful or impactful the programs are. Many case studies present examples of how individual green libraries promote green efforts and receive good community reactions, but without comparing them to other kinds of libraries, it's hard to tell if green initiatives make a difference. Because there has been little research comparing green libraries to others, we do not know whether environmental programming is more effective in green spaces or if it would be equally effective in standard libraries (Khan, Bhatti, & Iftakhar, 2023). Research focused on library users and community members helps explain the bigger impact of efforts to go green. Library studies keep showing that libraries play key roles in helping diverse communities achieve social inclusion and equity. At the moment, there is little research on whether green library designs change the mix of library members or make the library easier for all groups to use. Parts of the U.S. population continue to struggle with libraries because not all green practices are best for everyone (Adle, Behre, Real, & Jean, 2023). Exploring the economics of green building provides good information on analyzing how green projects in libraries might be rewarding, but there aren't many library-specific studies. In general, studies of eco-friendly buildings show that sustainable choices can cut long-term energy and water costs and also lead to increased worker productivity and lower employee absence rates. Before these results can be used in libraries, more study is necessary, as libraries focus on public service and community involvement, unlike most buildings studied under green building research (Mwanzu, Bosire-Ogechi, & Odero, 2023).

International experiences with green libraries point to differences in methods and main concerns based on where they are located. Environmental education and community sustainability are typically promoted in European studies, whereas North American research puts most effort into making buildings run more smoothly and reducing their impact on nature. More and more, Asian literature is pointing to green libraries as parts of smart city changes and strategies that promote sustainability in urban areas. Even so, limited studies on green library efforts and how they relate to communities restrict our knowledge of what is useful in all parts of the world versus what matters only in particular places (Rahoo, at el, 2021; Mollah, 2024). The field of methodological research studying green libraries discovers that it is difficult to cover both the environmental and community sides of such studies at once. Environmental assessment makes use of standard methods and data collected year after year, but measuring community engagement can be challenging with its many aspects. It is very difficult to study the effectiveness of a green library by combining numbers with observations, as so far only a few research investigations have tried this. Difficulties with methods may be one reason for the lack of empirical research in this field (Mwanzu, 2022).

New developments in study methods which involve a mix of techniques and community participation,

offer effective methods for studying what makes a library green. Having standard measures of community engagement and the environment now available leads to increased opportunities for research comparison. Still, the key methodologies have not yet been applied to green library research in a major way, with the majority of studies counting on basic single-case or narrow research, thus limiting the usefulness of their results for library advances (Manna & De Sarkar, 2022). Library administrators, policymakers and communities considering making their libraries greener struggle, as there is a big difference between the research showing what can work and what does work in practice. Because few studies look at green library development from both an environmental and community perspective, it is unclear what trade-offs, collaborative opportunities and best solutions can be found. Since the link between green library approaches and community engagement is unclear, it is essential to study this connection empirically to inform how libraries should develop (Khalid et al., 2021).

Research Methodology

A mixed-methods approach was used to compare green library efforts and community outreach between sustainable libraries and traditional library buildings. A purposive sample of 24 libraries was chosen, 12 with green certification and 12 that were conventional but similar in terms of location and who they serve. Data was obtained in several ways, for example, from structured surveys of 480 library patrons, 48 semi-structured interviews with library administrators and staff and by tracking how the library is used over a period of six months. To gather information, the study depended on standard tools to examine environmental management, energy consumption, community involvement and user experience. Statistics were used to spot differences between green and traditional libraries in data, while reviewing responses from participants to identify major themes in each group. The researcher examined library policies, sustainability reports and community program records as part of triangulating the findings. The investigation team obtained ethical clearance from the institution's review board and all participants offered their signed consent before any data collection took place.

Results and Data Analysis

Quantitative Analysis

The quantitative analysis revealed significant differences between green and traditional libraries across multiple dimensions of community engagement and environmental performance. Statistical testing confirmed that these differences were statistically significant at the $p<0.001$ level for all major variables.

Table 1: Community Engagement Metrics Comparison

Metric	Green Libraries (n=12)	Traditional Libraries (n=12)	Difference	p-value
Average Daily Visitors	342 ± 67	243 ± 52	+40.7%	<0.001
Monthly Program Attendance	1,847 ± 312	1,204 ± 198	+53.4%	<0.001
Community Event Hosting (annual)	87 ± 15	56 ± 12	+55.4%	<0.001
Volunteer Participation Hours	2,341 ± 423	1,536 ± 287	+52.4%	<0.001
Meeting Room Utilization (%)	84.3 ± 8.7	67.2 ± 9.1	+25.4%	<0.001

Table 1 demonstrates that green libraries consistently outperformed traditional libraries in all community engagement metrics. Green libraries attracted 40.7% more daily visitors, with an average of 342 visitors compared to 243 in traditional libraries. Monthly program attendance was significantly higher in green libraries, with 1,847 participants compared to 1,204 in traditional facilities, representing a 53.4% increase. Community event hosting showed the most dramatic difference, with green libraries hosting 87 events annually compared to 56 in traditional libraries, a 55.4% increase. Volunteer participation hours were 52.4% higher in green libraries, indicating stronger community

investment and ownership. Meeting room utilization rates were also substantially higher in green libraries at 84.3% compared to 67.2% in traditional facilities.

Table 2: Environmental Performance Indicators

Indicator	Green Libraries	Traditional Libraries	Reduction/Improvement	p-value
Energy Consumption (kWh/sq ft/year)	18.7 ± 3.2	28.4 ± 4.1	-34.2%	<0.001
Water Usage (gallons/sq ft/year)	0.89 ± 0.15	1.34 ± 0.21	-33.6%	<0.001
Waste Diversion Rate (%)	76.3 ± 6.8	41.2 ± 5.9	+85.2%	<0.001
Carbon Footprint (tons CO2/year)	127 ± 23	198 ± 31	-35.9%	<0.001
Renewable Energy Usage (%)	68.4 ± 12.3	12.1 ± 8.7	+465.3%	<0.001

Table 2 illustrates the substantial environmental benefits achieved by green libraries. Energy consumption was 34.2% lower in green libraries, with an average of 18.7 kWh per square foot annually compared to 28.4 kWh in traditional libraries. Water usage showed similar improvements with a 33.6% reduction in green libraries. The most significant difference was observed in waste diversion rates, where green libraries achieved 76.3% diversion compared to 41.2% in traditional libraries, representing an 85.2% improvement. Carbon footprint reduction was 35.9% in green libraries, and renewable energy usage was dramatically higher at 68.4% compared to only 12.1% in traditional facilities.

Table 3: User Satisfaction and Experience Ratings

Satisfaction Category	Green Libraries (Mean ± SD)	Traditional Libraries (Mean ± SD)	Difference	p-value
Overall Satisfaction (1-5 scale)	4.6 ± 0.4	3.8 ± 0.5	+21.1%	<0.001
Facility Comfort	4.7 ± 0.3	3.6 ± 0.6	+30.6%	<0.001
Lighting Quality	4.8 ± 0.2	3.9 ± 0.4	+23.1%	<0.001
Air Quality	4.5 ± 0.4	3.7 ± 0.5	+21.6%	<0.001
Noise Management	4.3 ± 0.5	3.5 ± 0.6	+22.9%	<0.001
Environmental Awareness Impact	4.4 ± 0.4	2.9 ± 0.7	+51.7%	<0.001

Table 3 reveals significantly higher user satisfaction ratings across all categories in green libraries. Overall satisfaction scores averaged 4.6 out of 5.0 in green libraries compared to 3.8 in traditional libraries, representing a 21.1% improvement. Facility comfort showed the largest difference with green libraries scoring 4.7 compared to 3.6 in traditional libraries, a 30.6% improvement. Lighting quality, air quality, and noise management all received higher ratings in green libraries. Notably, environmental awareness impact showed the most substantial difference, with green libraries scoring 4.4 compared to 2.9 in traditional libraries, indicating that users recognized and valued the environmental education and consciousness-raising aspects of green library initiatives.

Table 4: Program Diversity and Participation Analysis

Program Type	Green Libraries (Annual Offerings)	Traditional Libraries (Annual Offerings)	Participation Difference
Environmental Education	34 ± 6	8 ± 3	+325%
Sustainability Workshops	28 ± 5	4 ± 2	+600%
Community Gardening	15 ± 3	2 ± 1	+650%
Green Technology Demos	12 ± 2	1 ± 1	+1100%
Cultural Events	47 ± 8	41 ± 7	+14.6%
Educational Programs	52 ± 9	48 ± 8	+8.3%
Children's Activities	89 ± 14	76 ± 12	+17.1%

Table 4 demonstrates the diversity of programming offered by green libraries, particularly in environmental and sustainability-focused areas. Green libraries offered 325% more environmental education programs, 600% more sustainability workshops, and 650% more community gardening programs compared to traditional libraries. Green technology demonstrations were offered 1100% more frequently in green libraries. While traditional program categories like cultural events and educational programs showed modest increases, the dramatic expansion in environmental programming contributed significantly to overall community engagement.

Table 5: Demographic Diversity and Community Reach

Demographic Category	Green Libraries (% of Users)	Traditional Libraries (% of Users)	Difference
Age 18-35	34.2%	24.1%	+41.9%
Age 36-55	28.7%	31.2%	-8.0%
Age 56+	22.4%	29.8%	-24.8%
Families with Children	38.9%	27.6%	+40.9%
Ethnic Minorities	31.7%	22.4%	+41.5%
College-Educated	67.3%	58.2%	+15.6%
Environmental Activists	18.6%	3.7%	+402.7%

Table 5 reveals that green libraries attracted a more diverse user base, particularly among younger adults, families with children, and ethnic minorities. The proportion of users aged 18-35 was 41.9% higher in green libraries, while families with children represented 40.9% more of the user base. Ethnic minority representation was 41.5% higher in green libraries. Notably, environmental activists comprised 18.6% of green library users compared to only 3.7% in traditional libraries, indicating that sustainability initiatives attract environmentally conscious community members who might not otherwise engage with library services.

Qualitative Analysis

Key themes explaining the better community engagement scores of green libraries were discovered during the analysis of interviews and observations. The interviews with staff revealed that discussing the green features allowed them to talk to users and explain their benefits. Often, users would mention

that they liked the improved atmosphere, thanks to natural light, better air in the green libraries and how quiet they are, spend more time in the library and engage more often in programs.
Community pride turned out to be important, as people began to feel more responsible for libraries that upheld their beliefs about the environment. Thanks to solar panels, green roofs and energy displays being clearly seen, there were many opportunities for learning and discussing the environment with others. Librarians noted that having green libraries made some new groups—environmentally conscious families and young professionals who avoid libraries—feel more comfortable using library resources.
Analysis of the programming found that eco projects improved and supported the usual library activities, rather than replacing them. Sometimes, these programs brought reading and writing skills into environmental classes and libraries helped organize and lead workshops on sustainability. The libraries' community gardens provided people with more areas to connect outside the building.
Researchers found evidence that greater social activity and chances for community building occur in green libraries. Users spent a lot of time having conversations, joining in with no-planned activities and expressing interest in different library activities. It seemed that the features of the environment supported people spending more time there and returning, helping the community to grow.

Discussion

Based on this research, green library initiatives help raise community engagement and provide significant environmental gains. All measured outcomes show high performance, proving that sustainability and community engagement work well together. Those libraries with green features called more people each day and attracted over half of all attendees to their events, revealing their suitability for community activities. Since there's a much greater interest in hosting community events by 55.4%, green libraries are now more often chosen by groups in the community.
Green library design is shown to be effective by the positive environmental performance results. A drop of 34.2% in energy use and 35.9% lower carbon emissions shows libraries can do a lot for the environment while maintaining their services. Apparently, making the library more environmentally friendly seems to actually make users enjoy the experience more. This significant increase in waste diversion means green libraries inspire others by showing examples and offering education.
Results from demographic studies suggest that green libraries attract a better mix of younger adults, families and ethnic minorities. With a broader range of materials, the library becomes more closely involved in the community and helps more people get involved in local activities. The fact that environmental activists make up 402.7% more of the green library users than the rest of the population demonstrates that new and unconnected community members are becoming part of the library's influence. According to this study, having green libraries could connect environmental organizations with traditional library users and inspire a sharing of ideas and activities.
What was learned through the qualitative approach shows how green design promotes community involvement. New fitness spaces, added education and eco-friendly commitments give people several ways to feel bonded with each other. Evidence that community pride is a major theme reveals that green libraries work toward building the sense of community and community cohesion and not only directly serve customers.

Conclusion

This research shows that green library movements aid both our environment and our society by contributing to these areas. The study shows that increasing environmental responsibility makes libraries more effective in their usual community activities and introduces new potential for community and civic interaction. All the measured characteristics, like usage and community and environmental effects, were performed better by green libraries.
According to the study, putting environmental sustainability first may lead to greater community participation, rather than taking it away from other areas of library growth. It is clear from improved user satisfaction and an increase in visitors that introducing green elements makes community spaces

both attractive and useful. Increases in environmental programming, combined with solid results in regular program areas, support the belief that sustainability efforts complement, rather than take the place of, main library services.

This study shows that green libraries attract more diverse groups and can help them become community institutions that actively serve everyone. Green libraries are appealing to younger adults, families and ethnic minorities, suggesting that libraries' sustainability policies match what diverse people consider important.

The information in the study demonstrates how libraries are guiding the way toward community sustainability, boosting their community outreach and increasing their services. When environmental stewardship and community involvement work together, public institutions can benefit from the approach which makes libraries leaders in promoting sustainability and uniting communities.

Recommendations

It is important for a library's top leaders and policy makers to consider green library development as an important step toward protecting the environment and improving community connections. The study results reveal that green measures lead to greater usage, increased satisfaction and more involvement from the community, making the first investment in sustainable ways of doing things highly justified. Libraries planning to renovate or build should include sustainability features, including renewable energy and good building design and education about the environment, because these aspects bring positive changes for engaging the community and operating efficiently.

Both communities and groups that provide funding should view green libraries as choices that help the environment and society at the same time. Because green libraries encourage a broader range of people to visit and become involved, sustainability efforts should be seen as approaches to growing a community instead of just helping the environment. Researchers should study how the efforts of green libraries impact the environment and society over time and how to design these libraries for the greatest benefit.

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